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**UNITED STATES DEPARTMENT OF AGRICULTURE
SCIENCE AND EDUCATION ADMINISTRATION
AGRICULTURAL RESEARCH**

**REPORT OF THE
RESEARCH PLANNING CONFERENCE ON WEED CONTROL
IN HORTICULTURAL CROPS**

**ORLANDO, FLORIDA
NOVEMBER 7 - 8, 1978**

**United States
Department of
Agriculture**



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Summaries of AR Scientists' Horticultural
Weed Research Programs

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CATALOGING PREP.

FOREWORD

The Planning Committee for the AR Research Planning Conference on Weed Control in Horticultural Crops consisted of J. R. Frank, N. C. Glaze, A. G. Ogg, Jr., W. V. Welker, and R. M. Menges, (Chairman). The Committee members express their appreciation to all participants in the Conference.

Special thanks is given to those scientists who presented research topics which served as background information in the development of recommendations for future research: Clyde C. Dowler, Integrated Pest Management; Baruch S. Shasha and Kenneth Savage, Controlled Release Herbicides; Maurice R. Gebhardt, Herbicide Application Equipment; Alan R. Putnam, Allelopathy; Kenneth E. Frick, Biological Control of Weeds; and Gale A. Buchanan, Population Dynamics of Weeds.

The Committee thanks Warren C. Shaw for his counsel and Wayne C. Currey for the informative tour of commercial ornamental production areas near Orlando, FL.

SUMMARY OF THE AR RESEARCH PLANNING CONFERENCE ON WEED CONTROL IN HORTICULTURAL CROPS

Five AR scientists involved in weed control research in horticultural crops and a few from other research disciplines met in Orlando, Florida, November 7 and 8, 1978, along with W. C. Shaw and R. Coleman, Staff Scientists, National Program Staff, and several scientists from SAES and Universities. The 24 participants a) reviewed the existing AR weed research programs in horticultural crops; b) discussed special research topics including integrated pest management, controlled release herbicides, equipment for herbicide applications, allelopathy, biological control, and population dynamics of weeds; and c) initiated the development of priority recommendations for future research on weed control in horticultural crops by AR. The priority recommendations were further developed through January 1979.

The most recent available data show that AR devotes 7.9 SY and \$537,550 to weed control research in all horticultural crops. Only 4% of the total AR research devoted to horticultural crop protection is appropriated to weed control research; whereas 50% is appropriated for insect control and 46% for disease and nematode control.

AR scientists have made significant contributions that have increased production efficiency and reduced losses in yield and quality and the cost of weed control in horticultural crops. They have been involved in the development of many of the herbicidal and cultural methods of weed control provided for the producers of vegetable, perennial fruit, ornamental and specialty crops.

Additional financial support is needed by all AR scientists conducting weed control research in horticultural crops. During the past 5 years, there has been a steady decline in monies available to the scientists. A minimum of \$105,000 is presently needed to support each scientist. In addition, the scientists need 25 acres of land for field research and \$556,000 for construction, equipment, and professional and technical aid to support their research programs.

Scientists attending the conference discussed research needs and the AR scientists developed the following recommendations for future AR research in horticultural weed control:

Priority 1. DEVELOP MORE EFFICIENT AND ECONOMICAL METHODS OF CONTROL FOR WEEDS RESISTANT TO THE METHODS PRESENTLY USED IN HORTICULTURAL CROPS.

An increase of 6 SY is recommended to supplement the 1.88 SY presently supported by AR for this research.

Priority 2. DEVELOP INTEGRATED SYSTEMS OF WEED MANAGEMENT WHICH WILL REDUCE LOSSES DUE TO WEEDS AND COSTS OF WEEDS; INCREASE YIELDS AND QUALITY OF HORTICULTURAL CROPS; AND PROTECT THE ENVIRONMENT.

An increase of 5 SY is recommended to supplement the 1.05 SY presently supported by AR for this research.

Priority 3. DETERMINE THE BIOLOGICAL, PHYSIOLOGICAL AND GENETIC RESPONSES OF HORTICULTURAL CROPS AND WEEDS TO WEED MANAGEMENT SYSTEMS TO SUPPORT THE DEVELOPMENT OF HERBICIDES THAT WILL CONTROL RESISTANT WEEDS AND CULTIVARS THAT WILL RESIST HERBICIDES.

An increase of 4 SY is recommended to supplement the 2.97 SY presently supported by AR for this research.

Priority 4. DEVELOP AND ADAPT EQUIPMENT AND METHODS FOR MORE EFFICIENT WEED CONTROL IN HORTICULTURAL CROPS AND FOR COMPATIBILITY WITH THE ENVIRONMENT.

An increase of 3 SY is recommended to supplement the 1.13 SY presently supported by AR for this research.

Priority 5. STUDY THE INTERFERENCE OF WEEDS IN HORTICULTURAL CROPS TO DETERMINE THE INTEGRATED WEED MANAGEMENT SYSTEMS NECESSARY TO CONTROL THE MOST SERIOUS WEED PESTS IN THE ECOSYSTEM.

An increase of 3 SY is recommended to supplement the 0.87 SY presently supported by AR for this research.

Recommendations were made on the locations for expanded AR research for weed control in horticultural crops.

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A. Summary of AR Weed Research Programs in Horticultural Crops

All research by AR on weed control in horticultural crops is conducted by the following six scientists:

W. V. Welker, Research Horticulturist
New Brunswick, NJ

J. R. Teasdale, Plant Physiologist
Beltsville, MD

J. R. Frank, Research Horticulturist
Frederick, MD

N. C. Glaze, Plant Physiologist
Tifton, GA

R. M. Menges, Research Horticulturist
Weslaco, TX

A. G. Ogg, Jr., Plant Physiologist
Prosser, WA

All of the scientists listed above attended the Horticultural Crops Weed Control Research Planning Conference, except J. R. Teasdale who joined USDA, SEA, AR November 5, 1978. These scientists devote a total of 6 SY to weed control in horticultural crops. More detailed information on these scientists is presented in the Appendix.

A summary of existing AR research on weed control in horticultural crops is given below by location, with listing of titles and objectives of CRIS projects as of December 15, 1978.

New Brunswick, NJ: W. V. Welker

Title - Develop weed control practices for perennial horticultural crops (1305-10240-002)

Objectives: Develop new and improved methods of utilizing those herbicides presently available. Evaluate new herbicides for their possible use in perennial plantings and effectiveness on specific weed problems with emphasis on perennial weeds. Investigate the interaction between herbicides, dwarfing root stocks and varieties in apples. Determine the effects of repeated long-term use of herbicides on perennial horticultural crops. Study whether cultivation is needed when all weeds are controlled with herbicides in tree fruit plantings.

W. V. Welker devotes 100% of his research to weed control in perennial horticultural crops.

Frederick, MD: J. R. Frank

Titles - Weed control and residue studies on specialty crops
(1208-20280-001)

Weed control and herbicide residue studies in selected
vegetable crops (1090-20282-001A)

Herbicide evaluation studies on greenhouse carnations and
roses--minor use pesticides (1090-20282-003A)

Objectives: Evaluate selected herbicides and growth regulators for
efficacy in weed control and possible crop toxicity under field con-
ditions on specialty and horticultural crops. Provide residue infor-
mation on selected herbicides and specialty or horticultural crops in
assessment of environmental hazards for herbicide registration.
Develop full season weed control methodology for use in the production
of horticultural crops.

J. R. Frank devotes 100% of his research to weed control on ornamental,
vegetable and specialty crops.

Tifton, GA: N. C. Glaze

Titles - Herbicide evaluation and residue analysis in vegetables
and ornamentals (7702-20287-001)

Weed control in container-grown ornamentals (7702-20287-
002A)

Control of nutsedge and broadleaf weeds in selected
horticultural crops (7702-20280-004)

Objectives: Develop new and improved methods of controlling weeds in
horticultural crops. Study competitive effects of specific weeds on
selected horticultural crops. Determine varietal responses of various
vegetables to selected herbicides.

N. C. Glaze devotes 100% of his research on vegetable and ornamental crops.

Weslaco, TX: R. M. Menges

Titles - Weed control in vegetables and efficiency of herbicides in
field soils (7202-20280-001)

Evaluation of herbicides to support registration for use
on minor use crops (7202-20287-001)

Objectives: Develop new and improved methods for the control of
resistant annual and perennial weeds in horticultural crops. a)
Improve application methods and the precision placement of herbi-
cides in soil, b) Evaluate new candidate herbicides and determine
new uses for registered herbicides. Determine the effects of
different densities and complexes of weeds on the growth of horti-
cultural crops. Determine the effects of UHF electromagnetic energy
on the control of resistant weeds and determine the effects of
generated heat.

R. M. Menges devotes 100% of his research to weed control in vegetable crops.

Prosser, WA: A. G. Ogg, Jr.

Title - Develop weed control principles and practices for horticultural and specialty crops in the Northwest (5806-20280-002)

Objectives: Determine the effects of weeds on the quality of mint oil. Conduct ecological studies on nightshades and bermudagrass that will aid in development of control practices. Develop principles and practices affecting the application of herbicides through sprinklers in irrigation water. Determine the response of crops to herbicide residues in soil and develop methods to detoxify residues. Develop weed management practices for orchards. Develop efficacy, phytotoxicity and residue data for the registration of herbicides on minor crops or for minor uses. Determine the effects of herbicides on the growth, yield and quality of horticultural and specialty crops.

A. G. Ogg, Jr. devotes 100% of his research to weed control in horticultural and specialty crops.

B. Current Resources for Weed Research

Estimates of AR and SAES efforts devoted to weed control research in horticultural crops were obtained from AR National Research Program 20280 (Weed Control Technology for Protecting Crops, Grazing Lands, Aquatic Sites and Non-crop Land) (Table 1). The total AR effort in FY 1975 was 7.9 SY with an expenditure of \$537,550. Most of this effort was devoted to vegetables, fruit, and specialty crops. Efforts of SAES were concentrated in vegetable crops.

Comparative efforts of U. S. research on horticultural crop protection from insects, diseases and nematodes, and weeds is shown in Table 2. In FY 1974, the total AR effort devoted to crop protection from insects, diseases and nematodes, and weeds was 138.4 SY. Of the research effort in horticultural crop protection, 50% (69.9 SY) was designated for insect control, 46% (63.3 SY) for diseases and nematode control and 4% (5.2 SY) for weed control. These data also show that SAES also devote much greater effort to the control of other pests in horticultural crops than to weed control in horticultural crops.

Table 1. Research effort devoted to weed control in horticultural crops as indicated in AR NRP 20280^{1/}

	Support, FY 1975			
	AR		SAES	
	SY's	Dollars	SY's	Dollars
Vegetable Crops	3.5	248,436	15.9	975,944
Fruit, Nut, and Specialty Crops	4.0 ^{2/}	277,078	8.9	713,120
Florist and Nursery Crops	<u>0.4</u>	<u>12,036</u>	<u>7.6</u>	<u>449,512</u>
Totals	7.9	537,550	32.4	2,138,576

^{1/} From p 112 of NRP 20280. 1976.

^{2/} Includes 2.6 SY for research on control of narcotic plants and weeds in narcotic plants, mint, and hops.

Table 2. U.S. research on horticultural crop protection from insects, diseases and nematodes, and weeds.

	SY SAES, FY 1974 ^{1/}			SY ARS, FY 1974 ^{1/}		
	Diseases and			Diseases and		
	Insects	Nematodes	Weeds	Insects	Nematodes	Weeds
Citrus & Subtrop- ical Fruits	24.8	25.1	3.9	18.8	6.7	--
Deciduous & Small Fruits	53.1	65.2	6.1	18.5	17.1	0.9
Potatoes	6.7	21.8	1.7	1.7	8.3	0.2
Vegetables	44.9	84.0	16.4	21.5	25.3	2.9
Florist & Nursery Crops	<u>19.4</u>	<u>39.9</u>	<u>10.2</u>	<u>9.4</u>	<u>5.9</u>	<u>1.2</u>
Totals	228.3	236.0	38.3	69.9	63.3	5.2

^{1/} FY 1974 data for SAES and ARS summarized from Inventory of Agricultural Research FY 1974 for Activities 4500-4700; blank indicates no data.

C. Major Accomplishments by AR Scientists in Horticultural Weed Research

1. Demonstrated in a 7-year study that repeated annual applications of terbacil and diuron controlled weeds without reducing quality or yield of highbush blueberries. Applications of fluometuron, however, reduced yields after the third year. This research led to the use of terbacil and diuron as standards in the blueberry industry.
2. In a long-term study, certain varieties of apple exhibited good tolerance without yield reduction, whereas other varieties exhibited foliar symptoms, reduction in rate of growth, and severe reductions in yield after applications of terbacil. Although much of the research that resulted in registration for the use of herbicides in tree fruits was based on a single variety, this research illustrates the need for varietal studies.
3. Demonstrated that weed competition from a 12-inch strip of weeds in the tree row resulted in yield reductions in peaches.
4. Developed a continuous belt herbicide applicator to wipe non-selective herbicides on weeds without contacting the crop of cranberry. This technique has provided selective weed control and has reduced the chances of herbicide residues occurring in the crop.
5. Developed single- and multiple-season interrow weed control systems including glyphosate to commercially grow strawberries with or without the use of plastic mulches.
6. Developed a preplant and postplant weed management program including the application of alachlor and glyphosate suitable for the establishment of 17 species of woody nursery stock without cultivation in turf.
7. Demonstrated the feasibility of multiple cropping in the same growing season utilizing combinations of horticultural and agronomic crops with the inclusion of several levels of total pest control. The selection of specific crops and herbicides must be done so that all major weed species will be controlled or their life cycle disturbed at some time during the year.
8. Demonstrated that the selectivity and weed control spectrum of soil-applied herbicides in asparagus and watermelon can be increased with over-the-row-sprays of activated carbon; developed a spot-spraying device for carbon.
9. Developed new and improved application techniques for two highly selective herbicides for several vegetable crops. Studies of mechanical incorporation tools and depths of soil incorporation were necessary to determine crop safety.

10. Determined the movement and persistence patterns of bensulide, DCPA and trifluralin in furrow-irrigated soils. Herbicides were not appreciably moved downward in soil with rainfall once the applications were stabilized with mechanical incorporation. Herbicides did not accumulate after three annual applications, but higher rates of application, deeper incorporation and reduced tillage extended herbicide persistence up to 13 months.
11. Established the technical feasibility of UHF electromagnetic energy as a weed, disease, and nematode control technique without leaving chemical residues in crop production soils.
12. Demonstrated that Canada thistle, a troublesome perennial weed, can be controlled by soil fumigation without using a plastic tarpaulin.
13. Developed a program to control broadleaf perennial weeds in asparagus by utilizing properly timed and repeated applications of low rates of two herbicides.
14. Developed an herbicide application program to remove horseweed from mint fields after it was determined that the weed contained a highly unstable compound whose presence would destroy the value of mint oil as a flavoring agent.
15. Determined in studies with 11 cultivars of potato that 'Nooksack' and 'Norgold' were the most tolerant to foliar applications of metribuzin and 'Norchip' and 'White Rose' were the most susceptible. This research has been helpful to plant breeders in planning their research.
16. Demonstrated that selection of a herbicide for weed control in fruit tree nursery stock depends on the weed species to be controlled and the fruit tree rootstock to be grown. Also determined that seedling trees that survived the initial herbicide treatments sustained grafted buds as readily as those not treated.
17. Demonstrated that fall and spring split applications of herbicide outperformed single annual applications of herbicide with a 50% savings of chemical.
18. Demonstrated that the performances of certain herbicides applied through irrigation systems were equal or superior to those applied by conventional methods of application with marked savings of energy.
19. Developed considerable efficacy, phytotoxicity, and soil residue data for a number of herbicides in vegetable, fruit, specialty and ornamental crops for use in obtaining registration by the Environmental Protection Agency. Much of this research has been conducted through the AR Special Research Program on Minor Use Pesticides in cooperation with the IR-4 Program.

In summary, AR scientists have made significant contributions in recent years that have increased production efficiency, and reduced losses in yield and quality and the cost of weed control in horticultural crops. They have been involved in development of many of the herbicidal and cultural methods of weed control provided for the producers of vegetable, perennial fruit, ornamental and specialty crops.

D. Major Research Needs

Justification

Additional financial support is needed by all AR scientists conducting weed control research in horticultural crops. During the past 5 years, there has been a steady decline in monies available to the scientists. Much of this decline occurred from increasing costs of equipment and supplies, wages of laborers and salaries of scientists and support personnel without increased appropriations. A minimum of \$105,000 is presently needed to support each scientist including salaries of professional and support personnel, field and laboratory labor, travel, equipment purchases and maintenance, and supplies and publication expenses. All scientists funded through WRU 20280 receive a significantly lower level of financial support than most scientists funded through other WRU's.

Specific Needs for Individual Locations

New Brunswick, NJ:

An additional technician and an adequate operating budget is needed for the existing research program. Estimated total needed, \$50,000.

Frederick, MD:

One support professional and one technician with supporting budget. Estimated total needed, \$105,000.

Tifton, GA:

An additional scientist with support monies for technical help and equipment. Estimated total needed, \$105,000; high clearance tractor, \$11,000; 25 acres of land with irrigation facilities for field research, \$40,000.

Weslaco, TX:

One additional scientist with support funds for new lines of research. Estimated total needed, \$100,000; field research equipment storage building \$35,000.

Prosser, WA:

One additional scientist with technician and support funds. Estimated total needed, \$105,000; walk-in growth chamber, \$20,000.

E. Recommendations for Future Research

1. Priority Lines of Research. Scientists attending the Research Planning Conference discussed research needs and continued discussion by correspondence and telephone afterwards. Ratings were made on these needs and the following priorities were determined necessary to increase yield and quality of horticultural crops, reduce losses and costs of control and to assure a quality environment through increased research in weed control.

Priority 1. DEVELOP MORE EFFICIENT AND ECONOMICAL METHODS OF CONTROL FOR WEEDS RESISTANT TO THE METHODS PRESENTLY USED IN HORTICULTURAL CROPS

Research Approaches:

- a) Develop improved methods of utilizing registered herbicides including combinations of cultural, chemical, biological, varietal, physical and mechanical methods. Primary effort should be placed on control of Bermudagrass, sedges including purple and yellow nutsedges, johnsongrass, large crabgrass, field bindweed, Canada thistle, Amaranthus sp., camphorweed, brambles, barnyardgrass, lambsquarters, hairy nightshade, wild common sunflower, London rocket, Florida pusley, sicklepod, quackgrass, hairy bittercress, and yellow wood-sorrel.
- b) Study herbicide combinations and herbicide rotations in horticultural crops to control additional weed species and to avoid herbicide residues.
- c) Develop in horticultural crops, such as vegetables, the crop-herbicide-tillage rotations to reduce weed populations and prevent the establishment of perennial weeds; study cropping systems which disrupt the life cycle of resistant weeds and provide for precise timing of herbicide application.
- d) Study the effects of crop-weed residues on the growth of weeds and rotational crops to determine the possibilities for natural herbicides.
- e) Study the use of various controlled-release (CR) formulations of herbicides to control their movement and persistence in the environment and to increase horticultural crop safety; compare these formulations with other available protectants.

- f) Develop horticultural crops that are more competitive with weeds.

We recommend an increase of 6 SY to supplement the 1.88 SY presently supported by AR for this research.

Priority 2. DEVELOP INTEGRATED SYSTEMS OF WEED MANAGEMENT WHICH WILL REDUCE LOSSES DUE TO WEEDS AND COSTS OF WEEDS; INCREASE YIELDS AND QUALITY OF HORTICULTURAL CROPS; AND PROTECT THE ENVIRONMENT

Research Approaches:

- a) Determine the weed management components and the optimum level of weed management for the best crop production.
- b) Study the interactions between optimum weed control techniques (chemical, cultural, mechanical and biological) and other pesticides.
- c) Study the effects of pesticide combinations on crop or weed sensitization.
- d) Study the effects of weed control methods on other pests.
- e) Determine the effects of plant residues which may occur within integrated systems of weed management on herbicide adsorption, plant disease organisms, and secondary compounds.
- f) Study the effects of integrated systems of weed management on water quality to offer maximum protection for the environment.

We recommend an increase of 5 SY to supplement the 1.05 SY presently supported by AR for this research.

Priority 3. DETERMINE THE BIOLOGICAL, PHYSIOLOGICAL AND GENETIC RESPONSES OF HORTICULTURAL CROPS AND WEEDS TO WEED MANAGEMENT SYSTEMS TO SUPPORT THE DEVELOPMENT OF HERBICIDES THAT WILL CONTROL RESISTANT WEEDS AND CULTIVARS THAT WILL RESIST HERBICIDES

Research Approaches:

- a) Determine the response of weeds and horticultural crops to herbicides applied by different methods, under different environmental conditions and at different stages of plant growth; study herbicide movement and degradation.
- b) Determine the effects of intensive use of herbicides on plant growth.

- c) Determine physiological and anatomical characteristics of resistant weeds in order to improve methods of weed control.
- d) Determine the growth patterns of horticultural crops and weeds as affected by the interactions of herbicides, insects, and disease organisms.
- e) Determine relative sensitivities of breeding lines and cultivars of horticultural crops to herbicides and develop and/or select cultivars of horticultural crops resistant to herbicides; develop cultivars with genetically-enhanced potential for control of weeds.
- f) Conduct ecological studies on the life history of weeds.

We recommend an increase of 4 SY to supplement the 2.97 SY presently supported by AR for this research.

Priority 4. DEVELOP AND ADAPT EQUIPMENT AND METHODS FOR MORE EFFICIENT WEED CONTROL IN HORTICULTURAL CROPS AND FOR COMPATIBILITY WITH THE ENVIRONMENT

Research Approaches:

- a) Develop suitable equipment for the selective application of herbicides to the target species including i) precision placement of herbicides in soils by mechanical devices or by various irrigation systems including overhead, central pivot and drip irrigation, ii) equipment for the control of emergent weeds in herbicide-sensitive horticultural crops, iii) equipment for the application of selective herbicides in container-grown ornamentals on irregularly-shaped landscaped areas, iv) equipment for more precise application of granular formulations of herbicides in ornamental crops, v) methods and equipment to apply herbicides under foliage of ornamentals grown in containers.
- b) Determine the principles and concepts governing the use of controlled-release formulations of herbicides and the use of other crop protectants.

We recommend an increase of 3 SY to supplement the 1.13 SY presently supported by AR for this research.

Priority 5. STUDY THE INTERFERENCE OF WEEDS IN HORTICULTURAL CROPS TO DETERMINE THE INTEGRATED WEED MANAGEMENT SYSTEMS NECESSARY TO CONTROL THE MOST SERIOUS WEED PESTS IN THE ECOSYSTEM.

Research Approaches:

- a) Determine the effects of different densities of individual

weed species, complexes of species and periods of weed competition on the competitive capacity, yield, and quality of horticultural crops.

- b) Study the competitive capacities of different horticultural crop cultivars at different weed-crop densities.
- c) Study the dynamics of weed populations as affected by light, temperature, soil pH, moisture and phosphorus and other environmental variables.
- d) Study the effects of allelopathic compounds on weed and crop growth.
- e) Determine the stage of life cycle at which a weed species reproduces and the period during which it is most susceptible to control.
- f) Determine the causes of weed successions and the effects of one weed species on another.
- g) Study the feasibility of using remote sensing to survey the movements of weed populations in horticultural production areas.

We recommend an increase of 3 SY to supplement the 0.87 SY presently supported by AR for this research.

2. Locations for Future Research and Summary of Current Research and Priorities. Preferred locations for expanded research are summarized in Table 3.

Table 3. Suggested locations for expanded research in horticultural weed control, comparative ratings of priorities and current and recommended AR efforts by priority.

Priority No.	Title	Ratings of priorities (1-5) ^a	Present level ^b of SY _C	Recommended increase ^c in SY _C	Recommended		Discipline
					Location	Expanded research ^d Location %	
1	Develop methods for control of resistant weeds	1.5	1.88	6	NJ	22	Weed Sci., Agr. Eng., Soil
					WA	22	Sci., Pl. Physiol., Biochem.
					TX	21	
					GA	13	
					MD-F	13	
					MD-B	9	
2	Develop inte- grated systems of weed manage- ment	2.8	1.05	5	GA	23	Weed Sci., Pl. Physiol.,
					TX	14	Soil Sci., Hort., Ent.,
					WA	13	Pl. Path., Agr. Eng.
					CA	13	
					FL	11	
					MD-B	10	
					MD-F	8	
					NJ	8	
3	Determine bio- logical, phys- iological, and genetic re- sponses of horticultural crops and weeds	3.3	2.97	4	NJ	20	Hort., Pl. Physiol., Pl.
					MD-B	17	Genetics, Weed Sci.
					TX	14	
					W VA	14	
					GA	13	
					MD-F	11	
					WA	11	

Table 3. (Continued)

Priority No.	Title	Ratings of priorities (1-5) ^{a/}	Present level ^{b/} of SY ^{c/}	Recommended increase in SY ^{c/}	Recommended Location for Expanded research ^{d/}		Discipline
					Location	%	
4	Develop equip- ment and methods for more effi- cient control	3.5	1.13	3	NJ WA TX GA MD-F FL	27 26 26 10 8 3	Agr. Eng., Hort., Weed Sci.
5	Study the interference of weeds in horticultural crops	3.8	0.87	3	WA TX GA NJ MD-B MD-F	24 23 18 14 13 8	Pl. Physiol., Pl. Ecol., Weed Sci., Hort.
Totals			<u>7.9</u>	<u>21</u>			

^{a/} = Highest priority.^{b/} = Scientist year.^{c/} Increase within 7 years.^{d/} % of total effort for each priority; MD locations are Frederick (F) and Beltsville (B).

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AR Weed Research Programs

1. Primary and related NRP's: 20280, 20282
2. Number and title of CRIS Work Unit.
 - 1203-20280-001 - Weed control and residue studies on specialty crops
 - 1090-20282-001A - Weed control and herbicide residue studies in selected vegetable crops
 - 1090-20282-003-A - Herbicide evaluation studies on greenhouse carnations and roses - Minor use pesticides
3. Locations. Frederick, Maryland; Salisbury, Maryland; and Raleigh, North Carolina
4. Scientist's name, address, and telephone number.

J. Ray Frank, Research Horticulturist
USDA-SEA-AR
P. O. Box 1209
Frederick, MD 21701

Phone: Comm. 301-663-7132
FTS 301-935-7132
5. Current SY's. NRP 20280 - 1 SY
6. Percent of time devoted to weed research. 100%
7. Mission of research. This research program is designed to develop new and improved weed control technology for use in horticultural crops that will increase efficiency in food and other specialty plant production, by reducing losses in yield and quality, reduce the cost of weed control while minimizing pesticide impact on the environment.
8. Objectives of research.
 - A. To evaluate selected herbicides and growth regulators for efficacy in weed control and possible crop toxicity under field conditions on specialty and horticultural crops.
 - B. To provide residue information on selected herbicides and specialty or horticultural crops in assessment of environmental hazards for herbicide registration.

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C. To develop full season weed control methodology for use in the production of horticultural crops.

9. Status of current research in meeting NRP 20280 objectives. Research concerned with the current objectives of this program is being continued actively in response to the immediate needs for effective, ecologically safe, weed control methodology for all specialty crops.
10. Significant research accomplishments. Developed single season and multiple season interrow weed control systems which can be used to establish and grow strawberries for commercial production with or without plastic mulch. This research also led to the commercial development of glyphosate for future label amendment.

Developed a preplant, postplant, and postplant-directed spray program which can be used for establishing woody nursery liners in turf, without cultivation, for the required multiple year production period. Included in this research was the development of field data on weed control efficacy and crop phytotoxicity obtained for glyphosate in preplant and postplant applications and for alachlor in preplant and full-season applications in combination with glyphosate on 17 species of woody nursery stock.

Large-scale field studies resulting in data on weed control efficacy, crop toxicity and residue information for paraquat as a directed spray on tomatoes grown with and without black plastic mulch. Data was used for label amendment. Similar studies were conducted and data was developed for sweet peppers using paraquat. This data was used for product registration.

Research efficacy and phytotoxicity data was developed for use in obtaining a label amendment for the use of paraquat in strawberry culture.

Following cooperative research with the University of Maryland, data have been obtained on weed control efficacy, crop phytotoxicity and herbicide residues in crops for glyphosate and linuron on asparagus. This data will be used for obtaining label amendments. Research data of this type has also been developed for future use in amending the propachlor label so this compound can be used for onions.

Cooperative research with the North Carolina State University has developed data for future use in obtaining label amendments for several compounds needed for weed control in the greenhouse production of roses and carnations.

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11. Impact of research accomplishments on science and general public. The research accomplishments in this program are dominated by the reduced cost of weed control practices. The research data generated by these projects has led to prompt registration of herbicides which will be safe to use while controlling weeds, at a reduced cost, without yield reduction. The data collected has also been used to establish finite tolerances of residues for herbicides on selected specialty crops.

Our research has also led to the development and label amendment of several compounds needed for horticultural crop production which were previously registered for use in agricultural field crop production only.
12. Obstacles to achieving objectives. The program lacks full time technicians because none are assigned to the project. Additional professional scientific support persons are also needed. The field staff responsible for planting and harvesting and other procedures is totally inadequate during peak seasons.
13. Future lines of needed weed research and plans for implementation. Research is needed to develop full season weed control methodology for many of our high cost intensive cropping systems including those for woody ornamentals, floral crops, vegetables and small fruits. Work is now under way in several of these important areas.
14. Research, facilities and personnel needs. There is a vacancy for a full-time technician. To operate at the level expected this position must be filled immediately. The future staffing should include an additional full-time support professional (GS-11 or 12). Full-time field technicians are also needed in the field support group to carry out a broad range of cultural practices required by specialty crop research.
15. Extent of cooperation - names of persons and institutions. Dr. C. E. Beste, University of Maryland, Salisbury, Maryland, cooperator in vegetable crop weed research; Dr. T. J. Monaco, North Carolina State University, Raleigh, North Carolina, cooperator in greenhouse floral crop weed research; Dr. R. T. Guest, IR-4 Project, Rutgers University, New Brunswick, New Jersey, cooperator in herbicide priority development.
16. Other considerations. Emphasis is needed to stress to OMB, members of Congress, and other uninformed groups concerning the importance of developing information for registration in providing lower costs within the specialty crop weed control areas.
17. Recommendations. Recommendations for the immediate needs of the specialty crop herbicide program: We must place our efforts in priority areas which can be pinpointed by an annual meeting of all specialty

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crop weed workers within the regions of the United States such as the North-east, etc. These meetings should include both state as well as AR workers.

18. Titles of publications for the past 3 years:

- Frank, J. R. 1976. Evaluation of paraquat on pepper and tomato transplants on plastic mulch. (Abstract). Proc. Northeast. Weed Sci. Soc. 30:180.
- Frank, J. R. and J. A. King. 1977. Evaluation of glyphosate and paraquat on strawberries. (Abstract). Proc. 31st Annual Meeting of NEWSS 31:271.
- Frank, J. R., J. A. King, P. C. Goetz, and W. E. Tozer. 1977. Comparing selected growth retardants for use on woody trees. (Abstract). Conference Proc. Plant Growth Regulator Working Group Fourth Annual Meeting, Hot Springs, Ark. p. 284.
- Abdel-Rahman, M., B. A. Schneider, and J. R. Frank. 1977. Plant Growth Regulator Handbook of the PGRWG. 1st ed. 94 pp.
- Frank, J. R., R. A. Creager, J. A. King, W. E. Tozer, T. L. Whigham, W. A. Haverinen, and P. C. Goetz. 1977. Controlling stem length of trees with 24 selected growth retardants. (Abstract). HortScience 12:398.
- Frank, J. R. and J. A. King. 1978. Glyphosate and paraquat for the establishment of woody nursery stock. (Abstract). Proc. 32nd Annual Meeting of NEWSS 32:284.
- Frank, J. R. and J. A. King. 1978. Directed sprays of glyphosate and paraquat for strawberry culture. Abstracts, WSSA Meeting, Feb. 8-10, 1978, Dallas, Texas, Abstract No. 12.
- Frank, J. R., J. A. King, E. E. Merchant, and J. P. Carroll. 1978. A research tool for sorting strawberries by size. HortScience 13:276-277.
- Frank, J. R., J. A. King, P. C. Goetz, and W. E. Tozer. 1978. Greenhouse evaluation of the response of ash and maple to growth inhibitors. HortScience 13:434-436.
- Frank, J. R. and J. A. King. 1979. Directed spray applications with glyphosate and paraquat in the woody plant nursery. Abstracts, WSSA Meeting, p.51, Abstract No. 107.
- Frank, J. R. and J. A. King. 1979. Herbicide combinations for use in establishing and maintaining woody nursery plants. (Abstract). Proc. NEWSS 33:262-263.
- Frank, J. R. and J. A. King. 1979. Metolachlor and alachlor for use in establishing woody nursery stock. Proc. NEWSS 33:228-231.
- Frank, J. R. and J. A. King. 1979. Glyphosate and paraquat for inter-row weeding of strawberries (*Fragaria annassa*). Weed Sci. (In press).
- Frank, J. R. (Contributor). Weed control for woody ornamental crops, Herbaceous ornamental crops and soil fumigants for horticultural beds and nurseries (pp 183-198) in USDA AH 447 - Guidelines for weed control. (In press).

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1. Primary and related NPR's: 20280, 20287
2. Number and title of CRIS Work Unit.
 - 7702-20287-002A - Weed control in container-grown ornamentals
 - 7702-20287-001 - Herbicide evaluation and residue analysis in vegetables and ornamentals
 - 7702-20230-004 - Control of nutsedge and broadleaf weeds in selected horticultural crops
3. Location(s). Primary - Tifton, Georgia
4. Scientist's name, address, and telephone number.

Norman C. Glaze, Plant Physiologist
USDA-SEA-AR
Coastal Plain Experiment Station
Tifton, GA 31794

Phone: Comm. 912-386-3355
5. Current SY's. NRP 20280 - 1 SY
6. Percent of time devoted to weed research. 100%
7. Mission of research. To improve efficiency and weed control in horticultural crop production.
8. Objectives of research.
 - A. Develop new and improved methods of controlling weeds in horticultural crops.
 - B. Study competitive effects of specific weeds on selected horticultural crops.
 - C. Determine varietal responses of various vegetables to selected herbicides.
9. Status of current research in meeting NRP 20280 objectives. Continue current objectives of developing improved herbicide treatments for vegetables and ornamentals. Continue research in pest management on intensive cropping sequences. Continue research on protectants to increase herbicide tolerance.

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10. Significant research accomplishments. Research has demonstrated that multiple cropping is possible for maximum land utilization and weeds can be controlled effectively utilizing combinations of agronomic and horticultural crops. The use of activated charcoal has been shown to increase tolerance where the crop has a marginal tolerance to the herbicide. Research has led to the registration, recommendation and widespread use of several herbicides on various vegetable and ornamental crops.
11. Impact of research accomplishments on science and general public. Research has been used extensively in obtaining EPA registrations for use in horticultural crops. The use of protectants, if legalized, could increase significantly the degree of weed control in certain crops and ultimately increase the yields obtained. Sickpod competition is proportional to the duration of competition which illustrates the need for long-term weed control throughout the growing season.
12. Obstacles to achieving objectives. New candidate herbicides are lacking in horticultural crops. In many cases, industry is not interested in registering compounds on minor crops due to the economics of the usage and the risks on high value crops. Shifts in weed spectra to those difficult to control are also occurring.
13. Future lines of needed weed research and plans for implementation. Pesticide interactions need elucidation as more instances of toxicity are being observed annually. The biology of various weed species needs further study to determine the best time and method of control. Integrated pest management studies need to be continued and expanded to develop multiple cropping systems and means of adequately controlling all major pests in an economic system.
14. Research, facilities, and personnel needs. An additional professional SY with adequate support for equipment and technical help are needed to study the wide spectrum of problems.
15. Extent of cooperation - names of persons and institutions. S. C. Phatak, Associate Professor, Univ. of Ga., Tifton, GA; W. A. Rohde, USDA-SEA-AR, Tifton, GA; C. C. Dowler, USDA-SEA-AR, Tifton, GA; A. W. Johnson, USDA-SEA-AR, Tifton, GA; and other state and federal personnel.
16. Other considerations. None
17. Recommendations.
 - A. Increase support to ongoing programs.
 - B. Addition of a scientist and appropriate technical and operational support.

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18. Titles of publications for the past 3 years.

- Glaze, N. C. 1975. Weed control in cucumbers and watermelons. (Abstract). Proc. SWSS 28:174.
- Glaze, N. C. 1975. Weed control in cucumber and watermelon. J. Amer. Soc. Hort. Sci. 100:207-209.
- Sumner, D. R., C. C. Dowler, A. W. Johnson, and N. C. Glaze. 1975. Disease, weed, nematode control in intensive cropping systems. Ga. Agr. Res. 16:4-7.
- Johnson, A. W., N. C. Glaze, and C. A. Jaworski. 1975. Combination of specific pesticides for multiple pest control on tomato. J. Amer. Soc. Hort. Sci. 100:203-206.
- Glaze, N. C. 1975. Weed control in snapbeans. (Abstract). Hort-Science 10:332.
- Glaze, N. C. 1976. Herbicides plus cultivation for weed control in sweet potatoes. (Abstract). Proc. SWSS 29:220.
- Johnson, A. W., D. R. Sumner, C. C. Dowler, and N. C. Glaze. 1976. Influence of three cropping systems and four levels of pest management on populations of root-knot and lesion nematodes. (Abstract). J. Nematol. 8:290-291.
- Sumner, D. R., C. C. Dowler, N. C. Glaze, and A. W. Johnson. 1976. Epidemiology of leafspots of turnip grown for leafy greens in intensive cropping systems. (Abstract). Proc. Amer. Phytopathol. Soc. 3:342
- Jaworski, C. A., N. C. Glaze, T. J. Ratcliffe, R. A. Flowers, and S. C. Phatak. 1977. Late blight in mature tomatoes and transplants in southern Georgia in 1976 and possible chemical control. HortScience 12:553-555.
- Phatak, S. C. and N. C. Glaze. 1977. Herbicide evaluation on tomatoes direct-seeded for transplants. (Abstract). Proc. SWSS 30:152.
- Glaze, N. C. and S. C. Phatak. 1977. Weed control in rabbiteye blueberries. (Abstract). Proc. SWSS 30:166.
- Glaze, N. C., E. D. Threadgill, and S. C. Phatak. 1977. Spot application of activated carbon to increase herbicide selectivity on watermelons. WSSA Abstracts 87:42.
- Glaze, N. C. 1977. Weed control in intensive cropping sequences. Proc. Pesticide Workshop, pp. 93-101.
- Phatak, S. C. and N. C. Glaze. 1977. Weed control in horticultural crops--problems and future developments. Proc. Pesticide Workshop, pp. 31-34.
- Dowler, C. C., N. C. Glaze, A. W. Johnson, and D. R. Sumner. 1977. Effect of some intensive cropping systems on weed ecology. WSSA Abstracts, p. 72.
- Sumner, D. R., N. C. Glaze, C. C. Dowler, and A. W. Johnson. 1978. Foliar diseases of turnip grown for greens in intensive cropping systems. Plant Dis. Repr. 62:51-55.
- Sumner, D. R. and N. C. Glaze. 1973. Interactions of herbicides and nematicides with root diseases of turnip grown for leafy greens. Phytopathology 68:123-129.

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- Sumner, D. R., A. W. Johnson, N. C. Glaze, and C. C. Dowler. 1978. Root diseases of snapbeans and southern pea in intensive cropping systems. *Phytopathology* 68:955-961
- Glaze, N. C. and S. C. Phatak. 1978. Weed control in snapbeans. (Abstract). *Proc. SWSS* 31:151.
- Phatak, S. C. and N. C. Glaze. 1978. Field tolerance of southern pea cultivars to metribuzin. (Abstract). *Proc. SWSS* 31:168.
- Phatak, S. C. and N. C. Glaze. 1978. Southern pea (cowpea) tolerance to metribuzin. *WSSA Abstracts*, p. 9.
- Glaze, N. C., S. C. Phatak, and E. D. Threadgill. 1978. Spraying system for spot application of chemicals. *WSSA Abstracts*, p. 28.
- Glaze, N. C. and S. C. Phatak. 1979. Herbicide evaluation in new blueberry plantings. (Abstract). *Proc. SWSS* 32. (Accepted for publication).
- Phatak, S. C. and N. C. Glaze. 1979. Weed control in sweet corn. (Abstract). *Proc. SWSS* 32. (Accepted for publication).
- Singh, Megh, N. C. Glaze, and S. C. Phatak. 1979. Weed control in container-grown ornamentals. (Abstract). *Proc. SWSS* 32. (Accepted for publication).
- Glaze, N. C., S. C. Phatak, and E. D. Threadgill. 1979. Spot application of activated carbon to increase herbicide selectivity on watermelon. *HortScience* (Submitted to journal).
- Phatak, S. C., V. Souza Machado, J. Fortino, and N. C. Glaze. 1979. Varietal tolerance of horticultural crops to metribuzin. *WSSA Abstracts* (Symposium), p. 115.
- Phatak, S. C., N. C. Glaze, and E. D. Threadgill. 1979. Spot application of activated carbon to increase herbicide selectivity on tomatoes. *WSSA Abstracts*, p. 44.
- Glaze, N. C. and S. C. Phatak. 1979. Comparison of conventional methods with herbicides injected into irrigation. *WSSA Abstracts*, pp. 47-48.
- Wilkinson, R. E., N. C. Glaze, C. C. Dowler, and C. T. Young. 1979. Turnip green, cucumber, snapbean and southern pea response to pesticides in intensive-cropping sequences. *J. Agr. & Food Chem.* (Submitted to journal).
- Sumner, D. R., N. C. Glaze, C. C. Dowler, and A. W. Johnson. 1979. Herbicide and nematicide treatments, root diseases, and yield of turnip grown for leafy greens in intensive cropping systems. *J. Amer. Soc. Hort. Sci.* (Submitted to journal).

APPENDIX

1. Primary and related NRP'S: 20280, 20020, 20190, 20300, 20510
2. Number and title of CRIS Work Unit.

7202-20280-001 - Weed control in vegetables and efficiency of herbicides in field soils

7202-20287-001 - Evaluation of herbicides to support registration for use on minor use crops
3. Location(s). Primary - Weslaco, Texas
4. Scientist's name, address, and telephone number.

R. M. Menges, Research Horticulturist
USDA-SEA-AR
P. O. Box 267
Weslaco, TX 78596

Phone: Comm. 512-968-5438
5. Current SY's. NRP 20280 - 1 SY
6. Percent of time devoted to weed research. Research 60%, Technical Advisor activities 20%, other committee assignments 20%.
7. Mission of research. To develop principles and practices for weed control in horticultural crops that will increase production efficiency, reduce losses in yield and quality and the cost of control.
8. Objectives of research.
 - A. Develop new and improved methods for the control of resistant annual and perennial weeds in horticultural crops. 1) Improve application methods and the precision placement of herbicides in soil, 2) Evaluate new candidate herbicides and determine new uses for registered herbicides.
 - B. Determine the effects of different densities and complexes of weeds on the growth of horticultural crops.
 - C. Determine the effects of UHF electromagnetic energy on the control of resistant weeds and determine the effects of generated heat.
9. Status of current research in meeting NRP 20280 objectives. Continue current objectives with the following priorities: a) development of herbicides for minor crops registration to meet the national priorities, b) weed competition, with remote sensing of weed populations and their movements and importance in agriculture.

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10. Significant research accomplishments. Developed new and improved application techniques for two highly selective herbicides for several vegetable crops. Studies of mechanical incorporation tools and depths of incorporation were necessary for crop safety.

Movement and persistence patterns for several major herbicides in furrow-irrigated soils showed that soil-applied bensulide, DCPA, and trifluralin herbicides were not moved appreciably downward in soil after rainfall once the applications were stabilized with mechanical incorporation. Herbicides did not accumulate after three annual applications, but higher rates of application, deeper incorporation, and reduced tillage extended herbicide persistence in furrow-irrigated soils up to 13 months.

UHF electromagnetic energy controlled several herbicide-resistant weed species without injury to field-grown cantaloupes and onions. Soil temperatures were increased by UHF and weed seed germination was inhibited for 7 months indicating toxicity in dormant seeds. Research established the technical feasibility of UHF electromagnetic energy as a weed, disease, and nematode control technique without leaving chemical residues in crop production soils.

In 1977-78, research data from 14 projects in 6 vegetable crops and 6 projects in roses were incorporated into the IR-4 Program to support the registration of pesticides for minor crops.

11. Impact of research accomplishments on science and general public. Our research has been used extensively in development of EPA-approved registration labels including precautions on planting of herbicide-sensitive rotation crops. Research on soil-incorporated herbicides is published in scientific journals, has been widely adapted on farms, and our techniques are now being used by other researchers.

Losses caused by weeds in vegetable crops have been decreased considerably by our research since the correct positioning of herbicides in soil at the time of weed seed germination greatly reduces the required concentration of herbicides. Not only is the cost of crop production reduced, but so is the use of energy in the manufacture of herbicides. In the research on the stabilization of herbicide applications in soils, we have protected the environment of adjacent production fields and that of nearby water bodies by the reduction of herbicide movement into the atmosphere or into flood waters.

In the past three years, our research program has had a value of approximately \$7 million.

Although the use of UHF for weed control is not yet practical due to the high cost of UHF transmitters and of fuel, our research has stimulated similar research in several laboratories in the U.S. and in other countries.

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12. Obstacles to achieving objectives. We lack new candidate herbicides for the control of weeds in minor crops. Weed spectra have changed through the use of a single herbicide allowing resistant species to flourish. The biology of weeds is poorly understood for several species which are pests in vegetable crops. Interactions between difficult pests and pesticides need study.

There are new administrative responsibilities in certain committee assignments and those attached to Technical Advisors that require considerable time from research. We need research assistance to allow adequate time for both research and these new responsibilities.

13. Future lines of needed weed research and plans for implementation. We initiated new research on the biology of weeds, specifically on germination and early growth patterns. We have begun new research on remote sensing to detect weed populations. Studies will be initiated in integrated weed management systems as other studies are terminated.
14. Research, facilities, and personnel needs. The most critical needs are for one additional SY with funds for new lines of research.
15. Extent of cooperation - names of persons and institutions. Dr. J. Robert Wayland, Sandia Laboratories, Albuquerque, NM; Harold Gausman, USDA-SEA-AR, Weslaco, TX. Cooperation with researchers with Texas A&M University entails an exchange of ideas.
16. Other considerations. None
17. Recommendations.

A. Termination of certain areas of research for others of greater priority.

B. Addition of personnel (scientist and technician).

Responsibilities of TA's in the MAPS System are important, but those individuals in small research programs need extra consideration; the responsibilities include many of those of the former Research Investigation Leader. I feel that the Research Administrators are doing a commendable job, but the lack of funds is stressing the whole system and we need more effective PR to Congress.

18. Titles of publications for the past 3 years.

Wayland, J., M. Merkle, F. Davis, and R. M. Menges. 1975. Control of weeds with UHF electromagnetic fields. Weed Res. 15:1-5.

Menges, R. M. 1976. Soil and topical applications of herbicides in cucumbers. (Abstract). WSWs Res. Prog. Rep. p. 65.

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- Millhollon, R. and R. Menges. 1976. The effects of ultra-high frequency (UHF) electromagnetic energy on the germination of johnsongrass seeds. (Abstract). WSWs Res. Prog. Rep. pp. 190-191.
- Menges, R. M. 1976. Postemergence application of herbicides in onions. (Abstract). WSSA Abstracts. pp. 27-28.
- Gausman, H. W., R. M. Menges, D. E. Escobar, J. H. Everitt, and R. L. Bowen. 1977. Pubescence effects spectra and imagery of silverleaf sunflower (Helianthus argophyllus Torr. & Gray). Weed Sci. 25:437-440.
- Menges, R. M. 1978. Role of USDA-ARS IR-4 liaison representatives. Proc. SWSS 31:182-184.
- Menges, R. M. 1978. Sequential applications of herbicides in cucumbers. (Abstract). WSSA Abstracts. pp. 27-28.
- Menges, R. M. (Contributor). Weed control in horticultural crops (45-page section) in USDA AH 447 - Guidelines for weed control. (In press).
- Wilkinson, R. E., J. R. Wayland, M. G. Merkle, and R. M. Menges. Disruption of cell membranes by UHF electromagnetic radiation. Studies in Natural Sciences. (In press).

APPENDIX

1. Primary and related NRP's: 20280, 20010, 20020, 20300, 20510
2. Number and title of CRIS Work Unit.

5806-20280-002 - Develop weed control principles and practices for horticultural and specialty crops in the Northwest
3. Location(s). Prosser, Washington
4. Scientist's name, address, and telephone number.

Alex G. Ogg, Jr., Plant Physiologist
USDA-SEA-AR
Irrigated Agriculture Research and
Extension Center
Prosser, WA 99350

Phone: Comm. 509-786-3454
5. Current SY's. NRP 20280 - 1 SY
6. Percent of time devoted to weed research. 100%
7. Mission of research. To develop principles and practices for controlling weeds that will increase the yield and quality of horticultural and specialty crops, reduce energy use and crop production costs, and minimize pesticide residues in the environment.
8. Objectives of research.
 - A. Determine the effects of weeds on the quality of mint oil.
 - B. Conduct ecological studies on nightshades and bermudagrass that will aid in development of control practices.
 - C. Develop principles and practices affecting the application of herbicides in irrigation water through sprinklers.
 - D. Determine the response of crops to herbicide residues in soil and develop methods to detoxify residues.
 - E. Develop weed management practices for orchards.
 - F. Develop efficacy, phytotoxicity and residue data for the registration of herbicides on minor crops or for minor uses.
 - G. Determine the effects of herbicides on the growth, yield and quality of horticultural and specialty crops.

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9. Status of current research in meeting NRP 20280 objectives. Current research will continue with some revision in about two years. We plan to expand our research effort to develop principles and practices affecting the application of herbicides in irrigation water through sprinklers.
10. Significant research accomplishments. Field research has shown that the troublesome perennial weed Canada thistle can be controlled by soil fumigation without using plastic tarps.

Activated carbon banded over the seeded row protected direct-seeded asparagus from herbicide injury without impairing weed control.

Research on the use of herbicide combinations in potatoes and tomatoes has broadened the spectrum of weeds controlled and has resulted in higher potato yields, greater crop safety, and reduced production costs.

Properly timed and repeated applications of low rates of two herbicides have been used to develop a control program for the difficult problem of selectively removing broadleaf perennial weeds from asparagus.

Oil from horseweed, a weed common to mint fields, was found to contain a highly unstable compound whose presence in mint oil would destroy the value of the oil as a flavoring agent. After systematic evaluation of herbicides, two herbicide treatments were developed that controlled weeds in mint fields and reduced greatly the need for cultivation.

A program for the control of weeds in hops was developed using properly timed and repeated applications of a mixture of two herbicides.

Field research has demonstrated that selection of a herbicide for weed control in fruit nurseries depends on the weed species to be controlled and the fruit tree rootstock to be grown.

11. Impact of research accomplishments on science and the general public. Weed control research by this unit has been instrumental in developing the weed control practices currently being used on potatoes, asparagus, sweet corn, tomatoes, mint, hops, and tree fruit nurseries growing in the irrigated regions of the Pacific Northwest. Based on increased production by improved weed control, decreased production costs (reduction in hand labor and cultivation), and improved crop quality, we estimated that our research has returned over thirty million dollars in the past three years to growers of the above-mentioned crops. Our research has made significant contributions to the safe use and registration of five herbicides for potatoes, three herbicides for asparagus, two for sweet corn, two for mint, two for hops, and one for tree fruit nurseries.

Research on herbicide-potato cultivar interactions has been beneficial to other weed scientists and to plant breeders in planning their research.

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The application of herbicides in irrigation water through sprinklers is a new development in weed control technology, and our research has provided basic information to other weed scientists and to the agricultural chemical industry in furthering the development of this new technology.

12. Obstacles to achieving objectives. Lack of professional scientific support (GS-11 or GS-12) to conduct research relating to specific objectives has become a major obstacle. Also, lack of technical support to conduct analytical analysis of soil and plant samples has hindered the achievement of several objectives. Lack of basic knowledge of ecology and biochemistry of weeds, particularly nightshade and bermudagrass, has impeded the development of control measures for these weeds in many crops.

Lack of basic knowledge of the behavior of herbicides in coarse-textured soils under sprinkler irrigation has hindered the development of weed control measures in orchards and vineyards.

13. Future lines of needed weed research and plans for implementation. Perennial grasses such as quackgrass and bermudagrass are becoming an increasing problem in all perennial horticultural crops. We plan to begin physiological and ecological studies on bermudagrass to obtain needed basic knowledge on this weed.

There is a pressing need for research on the control of weeds under reduced or minimum cultivation practices. Due to the large scope of this problem, more manpower is needed to work on this problem.

Information on the behavior of herbicides in coarse-textured soils under sprinkler irrigation is needed to develop control measures in orchards and vineyards. In 1979 we plan to begin laboratory experiments to determine the movement of herbicides in soil columns or on soil plates.

14. Research, facilities, and personnel needs. Additional scientific and technical assistance is the greatest need for this project. With increasing administrative responsibilities related to IR-4 projects, peer review panels, planning conferences, and special assignments less and less time is available to conduct research. If steps are not taken to correct this situation, the productivity (scientific manuscripts) of this project will decrease.

A walk-in growth chamber (\$20,000) is needed for detailed studies on the effects of herbicides on the growth of horticultural crops and associated weeds.

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15. Extent of cooperation - names of persons and institutions. Washington Asparagus Growers Association, Sunnyside, WA, Gene Coe, commodity funding; Washington Mint Commission, Pasco, WA, Harry Visser, commodity funding; Columbia River Orchard Foundation, Washington State University, Pullman, WA, funding for grape research; National Mint Research Council, Dick Carrington, I.P. Callison and Sons, Chehalis, WA, commodity research; Dr. Muhammed Ahmedullah, Washington State University, IAREC, Prosser, WA, cooperator in grape research; Dr. A. P. Appleby, Oregon State University, Corvallis, OR, cooperator in mint and hop research; Dr. Gary Lee, University of Idaho, Moscow, ID, cooperator in weed research; Dr. Larry Hiller, Washington State University, Pullman, WA, collaborator.
16. Other considerations. In 1977 and 1978 our effort in IR-4 projects was expanded greatly and in each of these years efficacy, phytotoxicity, and residue data were obtained for at least ten separate projects. We plan to continue this program for another three to four years.
17. Recommendations. I would like to see a reduction in administrative responsibilities so that I could conduct more research. I feel that scientists are being overburdened with responsibilities not directly related to research. I feel that there is a need to improve scientific training programs for USDA-SEA scientists.
18. Titles of publications for the past three years.

Ogg, A. G., Jr. and C. E. Zimmermann. 1976. Effects of paraquat and dinoseb in hops. Weed Sci. 24:493-495.

Graf, G. T. and A. G. Ogg, Jr. 1976. Differential response of potato cultivars to metribuzin. Weed Sci. 24:137-139.

Ogg, A. G., Jr. 1976. Responses of potatoes and weeds to herbicides. Coll. of Agric. Res. Bull. 844. 10 pp.

Ogg, A. G., Jr. 1978. Herbicides and activated carbon for weed control in direct-seeded asparagus (Asparagus officinalis). Weed Sci. 26:284-286.

Ogg, A. G., Jr. and M. W. Martin. 1978. Effects of herbicides on weed control, and growth and yield of direct-seeded tomatoes. Coll. of Agric. Res. Bull. 870.

Ogg, A. G., Jr. and D. W. Evans. 1978. Weed control in rill irrigated soybeans. Coll. of Agric. Res. Bull. 869.

APPENDIX

1. Primary NRP: 20280
2. Number and title of CRIS Work Unit.

1103-20280-003 - Develop principles and practices for weed control
in horticultural crops
3. Location. Beltsville, Maryland
4. Scientist's name, address, and telephone number.

John Teasdale, Plant Physiologist
USDA-SEA-AR
Room 27, Bldg. 001, BARC-West
Beltsville, MD 20705

Phone: Comm. 301-344-3250
5. Objectives of research.
 - A. Develop improved methods of weed control for horticultural crops.
 - B. Integrate weed control programs with other cultural practices in order to maximize production.
 - C. Determine the nature and magnitude of weed competition with crops.
6. Approach. Evaluate herbicides for weed control and phytotoxicity and contribute data for herbicide registration where needed. Determine the interactions between herbicides and other cultural practices which may effect weed control, such as use of various plastic or other mulches in vegetable production, multiple or sequential cropping, higher density crop production, and different container growth media for ornamental production. Evaluate methods for estimating crop yield losses due to weed competition and determine those factors which are most responsible for affecting the degree of weed crop competition. Most studies will be performed in the field while greenhouse and laboratory studies will complement field studies.

APPENDIX

1. Primary NRP: 20280
2. Number and title of CRIS Work Unit.

1305-10240-002 - Develop weed control practices for perennial horticultural crops
3. Location(s). Rutgers University, New Brunswick, New Jersey; Rutgers Cranberry and Blueberry Research Center, Chatsworth, New Jersey; Cream Ridge Tree Fruit Research Center, Cream Ridge, New Jersey; and Soils and Crops Research Center, Adelphia, New Jersey
4. Scientist's name, address, and telephone number.

W. V. Welker, Research Horticulturist
USDA-SEA-AR
Soils and Crops Department
New Jersey Agricultural Experiment
Station
P. O. Box 231
New Brunswick, NJ 08903

Phone: Comm. 201-932-9382
5. Current SY's. NRP 20280 - 1 SY
6. Percent of time devoted to weed research. 100%
7. Mission of research. To develop technology needed to improve weed control in horticultural crops that will increase production efficiency while reducing losses in yield due to weeds.
8. Objectives of research.
 - A. Develop new and improved methods of utilizing those herbicides presently available.
 - B. Evaluate new herbicides for their possible use in perennial plantings and effectiveness on specific weed problems with emphasis on perennial weeds.
 - C. Investigate the interaction between herbicides, dwarfing root stocks and varieties in apples.
 - D. Determine the effects of repeated long-term use of herbicides on perennial horticultural crops.
 - E. Study whether cultivation is needed when all weeds are controlled with herbicides in tree fruit plantings.

APPENDIX

9. Status of current research in meeting NRP 20280 objectives: This research program was recently reviewed and updated. The goals and objectives are current.
10. Significant research accomplishments. A 7-year study evaluating the influence of repeated annual applications of selected herbicide treatments upon plant vigor, yield, and weed control in highbush blueberries was completed. It was found that terbacil and diuron at normal use rates could be used each year without reducing quality or yield. Fluometuron caused no reduction in yield during the first three years; however, yields were seriously reduced from the fourth year on.

Differential response of apple varieties to a range of rates of terbacil was noted in a long-term study. Certain varieties exhibited foliar symptoms, reduction in rate of growth and severe reduction in yield. Other varieties exhibited good tolerance with no reduction in yield.

Weed competition from a narrow 12-inch strip of weeds in the tree row resulted in a marked reduction in yield in peaches.

A continuous belt herbicide applicator was developed to wipe herbicides on weeds without bringing herbicides into contact with the crop. Non-selective herbicides were applied to weeds in cranberries using the wiper resulting in excellent weed control without injury to the crop.

11. Impact of research accomplishments on science and the general public. Our research involving the long-term use of herbicides in blueberry plantings is of vital importance to the blueberry grower because of the large investment required for establishment of plantings and normal maintenance. Effective herbicides are crucially needed but they must not injure the crop in any way as a result of continuous use. These herbicides have become the standards in the blueberry industry based on our research.

Our research demonstrating a differential response of apple varieties to a range of rates of terbacil points out that more research is needed to further evaluate this response. Much of the research that resulted in clearance and use of herbicides on tree fruits was based on single variety studies. This research indicates that single variety studies are inadequate.

The new herbicide application technique using the continuous belt wiper provides many new opportunities for using contact systemic herbicides on weeds without injury to crops. It not only reduces the likelihood of damage to the crop, but also reduces the chance of residues occurring in the crop and affords new approaches to developing improved weed management systems in sensitive crops.

APPENDIX

12. Obstacles to achieving objectives. There are insufficient funds available to allow indepth studies. The cost of doing research in horticultural crops is much greater than in agronomic crops. Perennial horticultural crops require care all year. There is a great deal of hand work involved and it is costly.
13. Future lines of needed weed research and plans for implementation. We are unable to maintain and complete the research that we currently are conducting due to lack of funding. If funds were available, we would expand our research on genetic variability in the response of dwarf apple trees to herbicide treatment. We would also increase our studies of specific perennial weeds.
14. Research, facilities, and personnel needs. I need more technical assistance and an adequate operating budget. The state is providing excellent facilities.
15. Extent of cooperation - names of persons and institutions. Dr. Norman Childers, Rutgers University; Mr. Ernest Christ, Rutgers University; Dr. R. Flannery, Rutgers University; Dr. M. Dana, University of Wisconsin; Dr. R. Develin, University of Massachusetts; and Dr. T. Monaco, North Carolina State University
16. Other considerations. IR-4 projects have been expanded and currently involve cooperative research with six states.
17. Recommendations. Funding for ongoing projects should be increased before new work is initiated. The emphasis has been to fund currently popular areas of research while ignoring the needs of the projects we currently have even though these ongoing projects are sound and the information that will be generated from them is much needed. We also need more input at the discipline level and a closer relationship with our own discipline.
18. Titles of publications for the past 3 years.

Welker, W. V., Jr. 1976. Effect of glyphosate on cranberries. Proc. NEWSS 30:157.

Welker, W. V., Jr. 1976. Herbicide injuries that resemble virus diseases. pp. 347-354 in Virus diseases and non-infectious disorders of stone fruits in North America. USDA AH 437.

Welker, W. V. and John A. Meade. 1977. Sprayers for tree fruits. Proc. State Hort. Assn. of Penn. 118:39-41.

Welker, W. V. and John A. Meade. 1977. Weed control in blueberries and strawberries. Proc. State Hort. Assn. of Penn. 118:70-71.

Welker, W. V. 1977. Long-term use of herbicides in highbush blueberry plantings. Proc. NEWSS 31:270.

Welker, W. V. 1978. Applying herbicides with a wiper. Proc. NEWSS 32:95.

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- Welker, W. V. and D. N. Riemer. 1978. The effect of multiple applications of glyphosate upon waterlilies. Proc. NEWSS 32:338.
- Welker, W. V. (Contributor). Weed control in horticultural crops (31-page section) in USDA AH 447 - Guidelines for weed control. (In press).

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